DOOR CLOSER

FIELD OF THE INVENTION

This invention relates to a door closing devise for urging an opened door towards its closed position relative to a door frame.

BACKGROUND OF THE INVENTION

More particularly, the invention concerns improvements in a door closer which is of the kind that usually acts between a door leaf and a door frame. This type of door closer typically comprises a housing, a biasing element disposed in and connected to the housing, and a tension member having one end connected to the biasing element and another end which extends to an anchor element. The housing is normally installed in a bore in the door leaf and the anchor element installed in the door frame. However, the positions of the housing and the anchor element may be reversed. The biasing element comprises a spring which operates to bias the tension member inwardly of the housing, for closing the door. The tension member is flexible, and for this, an articulated element such as a chain is normally employed.

Door closers of this kind typically employ a conventional elongated chain formed of connecting links, each successive link in the chain having a body coupled by two link pins to two adjacent links, namely the links that precede and follow a given link along the chain. Usually, each link has two link plates that are laterally spaced relative to the longitudinal centre line of the chain, although other chain structures are possible, such as links that alternate one and two plates, or successive links with any number of plates. The link pins typically define parallel pivot axes. However, the use of such conventional elongated chains have considerable draw backs when used in door closers of the type described above.

The rotation of adjacent links in conventional elongated chains about a given pivot axis is largely unrestricted. This gives rise to several disadvantages when such chains are used in door closers.

For example, a conventional chain when working in concealed door closers, known in the art, suffers from excessive loss of force transmission because free articulation of the chain link results in frictional losses consequent to the side load imparted on the chain and door closer. Consequently, when such a chain is articulated (as required by door closers of the type described above) the chain is unable to transmit effectively a force throughout its chain length.

Typically, doors are mounted to a door leaf by a projecting hinge. When doors are required to be opened by large angles (for example, where doors are folded back on themselves by opening at an angle of greater than 100°, or even 180°), such hinges project from the door by typically two or more centimetres. In such cases, known door closers are unable to close doors which have been opened by large angles (for example greater than 100°, or even 180°), because they are unable to impart a sufficient force around such angles.

Furthermore, the unrestricted rotation of adjacent chain links can lead to such chains folding back upon themselves. This may happen, for example, when the door is forced shut, and may result in the chain "locking out" or becoming self-entangled.

A further disadvantage of employing such conventional chains arises from energy loss and structural damage due to friction between such chains and the housing/other surfaces.

SUMMARY OF THE INVENTION

The present invention at least partially aims to overcome the problems of the known door closers described hereinabove.

Accordingly, the present invention provides a door closer for mounting between a door leaf and a door frame comprising a housing for mounting in one of the door leaf or door frame, a biasing element disposed in and connected to the housing and a chain, the chain having one end connected to the biasing element and another end for mounting to the other of the leaf or door frame, the chain comprising a plurality of link elements mutually connected together, each link element having two opposing ends, mutually spaced in the direction of the length of the chain, each end having a shoulder portion, and adjacent link elements having opposed shoulder portions which are adapted to abut when the adjacent link elements of the chain are bent around a particular radius.

Preferably, the opposed shoulder portions have the same shape.

Preferably, the link elements have the same structure.

Preferably, the shoulder portions are substantially planar.

Preferably still, the shoulder portions are inclined to the transverse direction of the chain by an angle in the range of from 5 to 30 degrees.

Preferably, the shoulder portions are inclined to the transverse direction of the chain by an angle of about 14 degrees.

In one embodiment, the link elements are separated longitudinally across the chain by at least one spacer element which pivotally connects adjacent link elements together.

Preferably, the chain includes a plurality of such spacer elements, each spacer element having two opposing ends, mutually spaced in the direction of the length of the chain, each end having a shoulder portion, and adjacent spacer elements having opposed shoulder portions which are adapted to abut when adjacent spacer elements of the chain are bent around a particular arc or radius.

Preferably, the opposed shoulder portions of the spacer elements have the same shape.

Preferably, the spacer elements have the same structure.

Preferably still, the shoulders of the spacer elements are substantially planar.

Preferably, the shoulders of the spacer elements are inclined relative to the transverse direction of the chain by an angle in the range of from 5 to 30 degrees.

Preferably, the shoulder portions are inclined to the transverse direction of the chain by an angle of about 14 degrees.

Preferably, the spacer elements have the same structure as the linker elements.

In another embodiment, the chain of the door closer comprises two or more rows of link elements interleaved by spacer elements.

Preferably, the width of the chain consists of three link elements and two spacer elements.

Preferably, the link elements and spacer elements comprise one or more link plates.

In a further embodiment, the link elements are in the form of blocks, each block having two opposing faces, mutually spaced in the direction of the length of the chain, each face having a shoulder portion, and adjacent link elements having opposed shoulder portions which are adapted to abut when the adjacent link elements of the chain are bent around a particular radius.

Preferably, the opposing faces include a male or female portion of a pivotal connection, and adjacent blocks are pivotally connected through said male and female portions.

Preferably, one of the said opposing faces of a given block comprises a female portion of a pivotal connection, and the other of the opposing face of the block comprises male portion of a pivotal connection.

Preferably, the opposed shoulder portions have the same shape.

Preferably, the shoulder portions are substantially planar.

Preferably, the shoulder portions are inclined relative to the transverse direction of the chain by an angle in the range of from 5 to 30 degrees.

Preferably, the shoulder portions are inclined to the transverse direction of the chain by an angle of about 14 degrees.

Preferably, both male and female portions comprise a plurality of plates, and the plates of a male portion interleave with the plates of a female portion to form a sandwich-type construction.

Preferably, three plates of a male portion interleave with two plates of a female portion.

The present invention also provides a door closer for mounting between a door leaf and a door frame, the door closer comprising a housing for mounting in one of the door leaf or door frame, a biasing element disposed in and connected to the housing, and a chain, the chain having one end connected to the biasing element and another end for mounting to the other of the leaf or

door frame, the chain comprising a plurality of link blocks mutually connected together, each block having two opposing faces, mutually spaced in the direction of the length of the chain, wherein the opposing faces of each block comprise a male or female portion of a pivotal connection, and wherein adjacent blocks are pivotally connected through said male and female portions.

Preferably, one of the said opposing faces of a given block comprises a female portion of a pivotal connection, and the other opposing face of the block comprises a male portion of a pivotal connection.

Preferably, both male and female portions comprise a plurality of plates, and the plates of a male portion interleave with the plates of a female portion to form a sandwich-type construction.

Preferably, three plates of a male portion interleave with two plates of a female portion.

The applicant has found that a door closer comprising a chain consisting of link elements which have two opposing ends, mutually spaced in the direction of the length of the chain, each end having a shoulder portion, and adjacent link elements having opposed shoulder portions which are adapted to abut when the adjacent link elements of the chain are bent around a particular arc or radius, gives rise to several advantages.

Firstly, the applicant has made the discovery that a door closer comprising a plurality of such chain elements can effectively urge an open door towards its closed position even when the door is opened by large angles, for example 180°. Accordingly, such door closers provide a particular advantage when used with doors that employ projecting hinges which enable doors to be opened by large angles.

Without being bound by theory, it is believed that this effect arises because when a force from the biasing element of the door closer is applied to a chain consisting of such link elements and which is articulated around a particular minimum arc or radius so that the shoulders of each set of adjacent link elements abut, a component of the force can be transmitted across the whole length of the chain. Again, without being bound by theory, it is believed that a line of force coincident to the line of force of the biasing element can be transmitted simultaneously through each chain element.

Thus, a door closer comprising a chain consisting of such link elements enables the line of force from the biasing element of the door closer to be entirely or substantially coincident to the line of action of the door closer.

Secondly, the applicant has made the discovery that by providing shoulder portions which are adapted to abut when adjacent link elements of the chain are bent around a particular radius, the chain can be prevented from folding back on itself, thereby circumventing the problem of the chain "locking up" or becoming self-entangled when used in the door closer.

Thirdly, by providing a chain comprising such link elements, the chain can readily be adapted to bend round a particular arc or radius, and thereby circumvents the problem of energy loss and structural damage arising from friction of the chain with the housing of the door closer/other surfaces. For example, the above-mentioned shoulder portions can be inclined relative to the transverse direction of the chain at a selected angle so that the chain at a junction between two link elements may only articulate by the degree determined by the selected angle. Accordingly, a chain made from a sequence of such link elements can be limited to a known arc. For example, when the shoulders of each link element are inclined at an angle of about 14 degrees to the perpendicular transverse direction, each symmetrical chain link element pair effectively has a 28 degree movement before opposing shoulders contact. This provides a working arc of 30 mm approximate radius for link elements whose pivot points are separated by 8mm. Thus, when a door closer is fitted to the door leaf and door frame, the arc of the chain can be matched to the hinging arc and thus the line of force from the biasing element of the door closer can be entirely or substantially coincident to the line of action of the door closer.

The applicant has also discovered that a door closer using a chain comprising a plurality of link blocks mutually connected together, each block having two opposing faces, mutually spaced in the direction of the length of the chain, wherein the opposing faces of each block comprise a male or female portion of a pivotal connection, and wherein adjacent blocks are pivotally connected through said male and female portions, gives rise to several surprising advantages.

Firstly, such blocks are easy to assemble and merely require the adjoining of the male and female portions to form a pivotal connection.

Secondly, the use of such blocks circumvents the need to use link plates, and so avoids problems associated with lubricating adjacent surfaces of pivotally connected plates.

Furthermore, pivotally connecting the blocks according to the present invention requires relatively little or no pressure to be applied along the pivot axis, and so the pivot connection requires little or no lubrication (from, for example, the application of oil).

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a part sectional view of a door comprising a door closer according to the present invention.

Figure 2 is a plan view of two adjacent link elements of a chain used in a door closer according to the present invention.

Figures 3 shows a plan view of part of a chain used in the door closer according to a first embodiment of the invention. Figure 3 shows the chain when straight.

Figure 4 shows a plan view of part of a chain used in the door closer according to a first embodiment of the invention. Figure 4 shows the chain when articulated about a given radius.

Figure 5 is a side view of a part of a chain according to the present invention.

Figure 6 is a side view of a part of a chain according to the present invention.

Figure 7 is a plan view of part of a chain used in the door closer according to a second embodiment of the invention.

Figure 8 is a plan view of a chain element shown in Figure 7.

Figure 9 is a side view of two adjacent links in the part of the chain shown in Figure 7.

Figure 10 is plan view of part of a chain used in the door closer according to a third embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows how a door closer according to the present invention can be used for urging an opened door towards its closed position relative to a door frame. A housing element 2 comprising a biasing element 1 (shown in phantom) disposed in and connected therein is mounted in the leaf of a door 3, a mounting plate 10 (shown in phantom)being recessed into the door leaf and affixed thereto, for example by screws. A chain 4 comprising link elements 5 has one end 6 connected to the biasing element and another end 7 for mounting to the door frame 8 *via* an anchor element 100(shown in phantom) to which the chain 4 is coupled pivotally. The anchor element 100 may also have a mounting plate similar or identical to mounting plate 10. When the door is opened, the biasing element 1 exerts an inward force 9 which operates to bias the chain 4 inwardly of the housing, for closing the door. The biasing element 1 typically comprises a helical tension spring and the construction of such an element is well known in the art. Typically, the door closer will also incorporate a damper to provide a decelerated or damped closing action. Such dampers, for example hydraulic cylinder/piston dampers are well known in the art.

Conceivably, the positions of the housing and the anchor element may be reversed.

Referring to Figures 1-4, each link element 5 has two opposing ends 10 mutually spaced in the direction of the length of the chain. Each end has a shoulder portion 11, and adjacent link elements have opposed shoulder portions 12, 13 which are adapted to abut 14 when adjacent link elements are bent around a particular arc or radius 13. In the embodiment shown each end of a link element has two shoulder portions, although it will be appreciated that each end of a link element may comprise only one shoulder portion.

In the embodiments shown in Figures 1-4, each link element 5 is the same and each shoulder portion 11 is planar and inclined relative to the transverse direction of the chain by an angle 15 (see Figure 2). Alternatively, provided that opposed shoulder portions of adjacent links 12, 13 abut when adjacent link elements are bent around a particular radius, the shoulders are not restricted to being the same shape or planar.

As will be appreciated, the angle 15 with which the shoulders are inclined to the transverse direction of the chain will dictate the particular minimum arc or radius 13 around which adjacent link elements 5 can be bent. Accordingly, by choosing the one or more angles by which the shoulders are inclined, it is possible to provide a sequence of link elements which will

be limited to an arc of a predetermined radius. This can be matched to the hinging arc formed between the door leaf and door frame, as shown in Figure 1.

In the particular embodiment shown in Figure 5, the link elements 5 are separated longitudinally across the chain by spacer elements 16 which pivotally connect adjacent link elements together via a pivot pin 17. Clearly, the number of spacer elements 16 required will depend on the number of link elements 5. Each spacer element 16 has two opposing ends 18, mutually spaced in the direction of the length of the chain, and, typically, each end has a shoulder portion, with adjacent spacer elements having opposed shoulder portions which are adapted to abut when adjacent spacer elements of the chain are bent around a particular radius.

As for the linker elements 5, in the embodiment shown, each spacer element 16 has the same structure and each shoulder is planar (although other surface shapes may be employed) and inclined relative to the transverse direction of the chain by an angle in the preferred range of from 5 to 30 degrees, most preferably about 14 degrees. Each of these ends of the spacer elements 16 has two shoulder portions, although it will be appreciated that each end of a link element may comprise only one shoulder portion. In the embodiment shown, the spacer elements have the same structure and shape, and in turn, have the same structure and shape as the link elements, although it will be appreciated that the spacer elements need not all be the same, and need not be the same as the link elements. It will also be appreciated that the spacer elements need not comprise shoulder portions.

Referring to Figure 6, this shows how the embodiment described in Figure 5 can be assembled into rows of link elements 5 interleaved by spacer elements 16. The chain shown in Figure 5 has a width along the pivot axis of three link elements and two spacer elements, although the width can be varied by changing the number of rows of link elements required. The number of link elements 5 (and spacer elements 16) required along the width of the chain will vary depending on several factors, for example, the size of the link/spacer elements and the size/type of door the door closer is to act upon.

The link elements 5 and spacer elements 16 shown in Figures 5 and 6 are in the form of plates. However, as long as the link elements 5 and spacer elements 16 can be pivotally connected to each other, alternative forms of the link elements and spacer elements are possible. Other than the necessary feature of the shoulder portions, the shape of the link elements are not

particularly limited. As shown in Figures 1-4, the longitudinal sides of the link elements can have a recess 19 extending towards the centre of the link element.

Referring to Figures 7 to 9, in a second embodiment of the invention, the link elements 5 are in the form of unitary blocks 20. The blocks 20 may be produced by injection moulding a metal. Each block has two opposing faces 21 and 22, mutually spaced in the direction of the chain. Each face has a shoulder portion 23, and adjacent link elements have opposed shoulder portions 24, 25 which are adapted to abut when the adjacent link elements of the chain are bent around a particular minimum arc or radius. Each shoulder is planar (although other shaped surfaces may be employed) and inclined relative to the transverse direction of the chain. The angles of inclination of the shoulder may be the same as for the first embodiment (i.e. preferably from 5 to 30 degrees, most typically about 14 degrees to the perpendicular transverse direction). Alternatively, provided that opposed shoulder portions 24,25 of adjacent links abut when adjacent link elements 5 are bent around a particular arc or radius, the shoulders are not restricted to being the same shape or planar.

In the embodiment shown, each block 20 is identical and one opposing face of a given block has a female portion of a pivotal connection 26, and the other opposing face of the block has a male portion of a pivotal connection 27. As shown in Figure 7 and 9, the male and female portions 26 and 27 together form a pivotal connection. The form of the male and female portions is not particularly restricted. In Figures 7 to 9, the male and female portions 26 and 27 of the pivot connection comprise plates in the form circular lugs 28, each spaced apart relative to each other along the respective face. Each lug has a central hole 29 through which a hinge pin 30 can enter orthogonally. The circular lugs 28 of a male portion 26 interleave with the circular lugs 28 of a female portion to form a sandwich-type construction.

In an alternative construction (not shown), both opposing faces 21,22 of a block 20 can have a female portion of a pivotal connection (Type II block) or both can include a male portion of a pivotal connection (Type III block). In this construction, the Type II and Type III blocks would have to alternate in order for a pivotal connection to be formed between each block.

Each opposing face 21, 22 of the blocks are adapted to receive the male or female portion of the pivotal connection. In the construction shown in Figures 7 and 8, each face has a recess 32 between each lug 28 which is substantially flush with the connecting lug present on the face of the adjacent link element. In the construction shown in Figures 7 and 8, the recess 32 is in the

form of an arc which is flush with the circular lug of the adjacent face, thereby facilitating pivotal rotation of adjacent link elements 5.

In each of the two previous embodiments the shoulder portions are configured to be recessed backwardly away from the opposed shoulder portion of the adjacent link, in particular by having an inclined face which is inclined at an acute angle with respect to the longitudinal axis of the respective link. However, alternatively the shoulder portions may be configured to project forwardly towards the opposed shoulder portion of the adjacent link, in particular by having an inclined face which is inclined at an obtuse angle with respect to the longitudinal axis of the respective link. In one particular alternative embodiment, each recessed shoulder portion faces a respective projecting shoulder portion. The extent of any recess or projection depends upon the longitudinal dimensions of the links and the dimension of the arc or radius around which the chain is intended to be bent to exert a longitudinal closing force therealong.

Figure 10 shows a further embodiment of the invention. In this embodiment, the door chain includes link elements 5 in the form of unitary blocks 31. The unitary blocks 31 comprise the same features as described in respect of blocks 20 referred to above but differ in that they do not comprise shoulder portions.